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PERSONAL DATA: Born April, 26 1965, U.S. Citizen

EDUCATION:

Ph.D., Applied Physics, Yale University, 1993
Thesis Topic: *Transitions in the Quantum Hall Regime*
M.Phil. Applied Physics, Yale University, 1991
M.S., Applied Physics, Yale University, 1990

B.S. The College of William & Mary, 1987
High Honors – Physics; High Honors - Computer Science (double major)

EMPLOYMENT:

Project Leader, National Institute of Standards and Technology (NIST) (2000-present).

- Lead Team of ~10 Scientists (~8 Ph.D.) to develop metrology for emerging nanoelectronic information processing technologies.
- Initialized and Established NanoElectronic Device Metrology Project.
- Developed Research Teams to investigate (1) Molecular Electronics, (2) Si-based nanoelectronics and (3) organic electronics: three highly-promising nanoelectronic technologies

Physicist, Semiconductor Electronics Division, NIST (1993 - present).
Major Technical Thrusts:

- NanoElectronic Test Structure Development, Assessment, and Characterization (2000-Present).
- Electrical Metrology for CMOS Gate Dielectric Thickness (1995-2000).
- Novel magnetic field characterization techniques for semiconductor materials and devices (III-V & Si-based). (1993-1996).

AWARDS:

Department of Commerce Bronze Metal Recipient. Senior Member of IEEE, National Research Council Associate (1993-1995), USAF Laboratory Graduate Fellow (1989-1992), Becton Fellow (1987), Presidential Fellow, National Merit Scholar.

LEADERSHIP ROLES:

International Semiconductor Device Research Conference Committee (2003-present), Symposium Organizer for the Materials Research Society, Session Chair and Session Organizer for the March Meeting of the American Physical Society. Member of the Technical Advisory Board for the Semiconductor Research Corporation (SRC), National Nanotechnology Initiative advisor, International Technology Roadmap for Semiconductors advisor.

Journal Articles Currently Submitted and in Preparation

1. *"Electrical and Spectroscopic Characterization of Metal/Monolayer/Si Devices."* Richter, C.A.; Hacker, C.A.; Richter, L.J.; submitted June 2005.
2. "*Charge Transport in Al/AlO$_x$/Molecule/Ti/Al Devices."* Richter, C.A., D.R. Stewart, D.A.A. Ohlberg, R.S. Williams,; Chapter in Springer Verlag book on Nanoelectronics.
3. *"Dipoles and energy offsets at the gold—oligo(phenylene-ethynelene) interface."* Ganesh K. Ramachandra, Aaron Katzenmeyer, Bridger Anderson, Curt A. Richter. Intended for Journal of the American Chemistry Society Communications.
4. *"Electrostatic Bangap Engineering in Dual-Gated Silicon Nanowire Transistors."* Sang-Mo Koo, Qiliang Li, Monica D. Edelstein, Curt A. Richter, and Eric M. Vogel. Intended for NanoLetters.
5. *"All Organic Non-Volatile Memory Device Fabricated Using PDOT:PSS Micro Pores."* J. Suehle, O. Kirillov, L. Cohen, W. Wu, and C. Richter, Intended for Nature.
6. *"Variations in semiconducting polymer microstructure and hole mobility with spin coating speed."* D. M. DeLongchamp, B. M. Vogel, Y. Jung, M. C. Gurau, C. A. Richter, O. Kirillov, J. Obrzut, D. A. Fischer, S. Sambasivan, L. J. Richter, E. K. Lin submitted to *Chem. Mater.* (2005).
7. *"Influence of a water rinse on the structure and electrical properties of poly(3,4-ethylene dioxythiophene):poly(styrene sulfonic acid) films."* D. M. DeLongchamp, B. D. Vogt, C. M. Brooks, K. Kano, J. Obrzut, C. A. Richter, O. Kirillov, E. K. Lin, *submitted to Langmuir* (2005).

Published Manuscripts

1. *"Spectroscopic and electrical characterization of buried metal interfaces: Metal-molecule-silicon structures."* Richter, L.J., C.A. Richter, and C.A. Hacker, Abstracts Of Papers Of The American Chemical Society, 2005. 229: p. U704-U705.
2. *"Electrical characterization of Al/AlOx/molecule/Ti/Al devices."* Richter, C.A., D.R. Stewart, D.A.A. Ohlberg, and R.S. Williams, Applied Physics A-Materials Science & Processing, 2005. 80(6): p. 1355-1362.
3. *"Nanometre gaps in gold wires are formed by thermal migration."* Ramachandran, G.K., M.D. Edelstein, D.L. Blackburn, J.S. Suehle, E.M. Vogel, and C.A. Richter, Nanotechnology, 2005. 16(8): p. 1294-1299.
4. *"Silicon nanowires as enhancement-mode Schottky barrier field-effect transistors."* Koo, S.-M., M.D. Edelstein, L. Qiliang, C.A. Richter, and E.M. Vogel, Nanotechnology, 2005. 16(9): p. 1482-1485.
5. *"Reverse short channel effects in high-/i k/ gated nMOSFETs."* Han, J.P., S.M. Koo, E.M. Vogel, E.P. Gusev, C. DaEmic, C.A. Richter, and J.S. Suehle, Microelectronics Reliability, 2005. 45(5-6): p. 783-785.
6. *"Spectroscopic Characterization of Buried Metal Interfaces Using Backside FTIR and Metal-Molecule-Silicon Samples."* Hacker, C.A., C.A. Richter, and L.J. Richter,

Characterization and Metrology for ULSI Technology, AIP Conference Proceedings 2005, (788) 610-614.

7. *"Comparison of Si-O-C interfacial bonding of alcohols and aldehydes on Si(111) formed from dilute solution with ultraviolet irradiation."* Hacker, C.A., K.A. Anderson, L.J. Richter, and C.A. Richter, Langmuir, 2005. 21(3): p. 882-889.
8. *"Molecular devices formed by direct monolayer attachment to silicon."* Richter, C.A., C.A. Hacker, L.J. Richter, and E.M. Vogel, Solid-State Electronics, 2004. 48(10-11): p. 1747-1752.
9. *"High inversion current in silicon nanowire field effect transistors."* Koo, S.-M., A. Fujiwara, H. Jin-Ping, E.M. Vogel, C.A. Richter, and J.E. Bonevich, Nano Letters, 2004. 4(11): p. 2197-2201.
10. *"Comparative thickness measurements of SiO/sub 2//Si films for thicknesses less than 10 nm."* Jach, T., J.A. Dura, N.V. Nguyen, J. Swider, G. Cappello, and C. Richter, Surface and Interface Analysis, 2004. 36(1): p. 23-29.
11. *"Asymmetric energy distribution of interface traps in n- and p-MOSFETs with HfO/sub 2/ gate dielectricon ultrathin SiON buffer layer."* Han, J.P., E.M. Vogel, E.P. Gusev, C. D'Emic, C.A. Richter, D.W. Heh, and J.S. Suehle, IEEE Electron Device Letters, 2004. 25(3): p. 126-128.
12. *"Influence of buffer layer thickness on memory effects of SrBi2Ta2O9/SiN/Si structures."* Han, J.P., S.M. Koo, C.A. Richter, and E.M. Vogel, Applied Physics Letters, 2004. 85(8): p. 1439-1441.
13. *"Structural and chemical characterization of monofluoro-substituted oligo(phenylene-ethynylene) thiolate self-assembled monolayers on gold."* Hacker, C.A., J.D. Batteas, J.C. Garno, M. Marquez, C.A. Richter, L.J. Richter, R.D. van Zee, and C.D. Zangmeister, Langmuir, 2004. 20(15): p. 6195-6205.
14. *"Comparison of solution-based attachment of alcohols and aldehydes to Si(III) for molecular electronic applications."* Hacker, C.A., K.A. Anderson, L.J. Richter, and C.A. Richter, Abstracts Of Papers Of The American Chemical Society, 2004. 227: p. U875-U875.
15. *"A capacitance-voltage model for polysilicon-gated MOS devices including substrate quantization effects based on modification of the total semiconductor charge."* Vogel, E.M., C.A. Richter, and B.G. Rennex, Solid-State Electronics, 2003. 47(9): p. 1589-1596.
16. *"Molecular devices formed by direct monolayer attachment to silicon."* Richter, C.A., C.A. Hacker, and L.J. Richter, 2003 International Semiconductor Device Research Symposium (IEEE Cat. No.03EX741), 2003: p. 417-418.
17. *"Energy distribution of interface traps in high-k gated MOSFETs."* Han, J.P., E.M. Vogel, E.P. Gusev, C. D'Emic, C.A. Richter, D.W. Heh, and J.S. Suehle, 2003 Symposium on VLSI Technology. Digest of Technical Papers (IEEE Cat. No.03CH37407), 2003: p. 161-162.
18. *"Characterization of solution-based attachment of organic monolayers to Si(111) for molecular electronic applications."* Hacker, C.A., C.A. Richter, and L.J. Richter, Abstracts Of Papers Of The American Chemical Society, 2003. 225: p. U642-U642.
19. *"Thickness evaluation for 2 nm SiO/sub 2/ films, a comparison of ellipsometric, capacitance-voltage and HRTEM measurements."* Ehrstein, J., C. Richter, D. Chandler-Horowitz, E. Vogel, D. Ricks, C. Young, S. Spencer, S. Shah, D. Maher, B.

Foran, A. Diebold, and H. Pui Yee, AIP Conference Proceedings, 2003(683): p. 331-336.
20. *"Spectroscopic ellipsometry characterization of high-/b k/ dielectric HfO/sub 2/ thin films and the high-temperature annealing effects on their optical properties."* Yong Jai, C., N.V. Nguyen, C.A. Richter, J.R. Ehrstein, L. Byoung Hun, and J.C. Lee, Applied Physics Letters, 2002. 80(7): p. 1249-1251.
21. *"Spectroscopic ellipsometry characterization of high-k dielectric HfO2 thin films and the high-temperature annealing effects on their optical properties."* Cho, Y.J., N.V. Nguyen, C.A. Richter, J.R. Ehrstein, B.H. Lee, and J.C. Lee, Applied Physics Letters, 2002. 80(7): p. 1249-1251.
22. *"Challenges of high-k gate dielectrics for future MOS devices."* Suehle, J.S., E.M. Vogel, M.D. Edelstein, C.A. Richter, N.V. Nguyen, I. Levin, D.L. Kaiser, H. Wu, and J.B. Bernstein, 2001 6th International Symposium on Plasma- and Process-Induced Damage (IEEE Cat. No.01TH8538), 2001: p. 90-93.
23. *"Differences between quantum-mechanical capacitance-voltage simulators."* Richter, C.A., E.M. Vogel, A.M. Hodge, and A.R. Hefner, Simulation of Semiconductor Processes and Devices 2001. SISPAD 01, 2001: p. 340-343.
24. *"Optical and electrical thickness measurements of alternate gate dielectrics: a fundamental difference."* Richter, C.A., N.V. Nguyen, E.P. Gusev, T.H. Zabel, and G.B. Alers, AIP Conference Proceedings, 2001(550): p. 134-139.
25. *"A comparison of quantum-mechanical capacitance-voltage simulators."* Richter, C.A., A.R. Hefner, and E.M. Vogel, IEEE Electron Device Letters, 2001. 22(1): p. 35-37.
26. *"Characterization and production metrology of gate dielectric films."* Diebold, A.C., J. Canterbury, W. Chism, C. Richter, N. Nguyen, J. Ehrstein, and C. Weintraub, Materials Science in Semiconductor Processing, 2001. 4(1-3): p. 3-8.
27. *"Test chip for electrical linewidth of copper-interconnect features and related parameters."* Cresswell, M.W., N. Arora, R.A. Allen, C.E. Murabito, C.A. Richter, A. Gupta, L.W. Linholm, D. Pachura, and P. Bendix, ICMTS 2001. Proceedings of the 2001 International Conference on Microelectronic Test Structures (Cat. No.01CH37153), 2001: p. 183-188.
28. *"Characterization and production metrology of thin transistor gate dielectric films."* Chism, W., A. Diebold, J. Canterbury, and C. Richter, Diffusion and Defect Data Part B (Solid State Phenomena), 2001. 76-77: p. 177-180.
29. *"Limitations of conductance to the measurement of the interface state density of MOS capacitors with tunneling gate dielectrics."* Vogel, E.M., W.K. Henson, C.A. Richter, and J.S. Suehle, IEEE Transactions on Electron Devices, 2000. 47(3): p. 601-608.
30. *"Effects of high-temperature annealing on the dielectric function of Ta/sub 2/O/sub 5/ films observed by spectroscopic ellipsometry."* Nguyen, N.V., C.A. Richter, C. Yong Jai, G.B. Alers, and L.A. Stirling, Applied Physics Letters, 2000. 77(19): p. 3012-3014.
31. *"Spectroscopic ellipsometry of Ta/sub 2/O/sub 5/ on Si."* Richter, C.A., N.V. Nguyen, and G.B. Alers, Ultrathin SiO/sub 2/ and High-K Materials for ULSI Gate Dielectrics. Symposium, 1999: p. 559-566.

32. *"Ultrathin SiO/sub 2/ and High-K Materials for ULSI Gate Dielectrics."* Huff, H.R., C.A. Richter, M.L. Green, G. Lucovsky, and T. Hattori. MRS Symposium Proceedings. Vol. 567. 1999: Materials Research Society. 615.
33. *"Characterization of thin SiO/sub 2/ on Si by spectroscopic ellipsometry, neutron reflectometry, and X-ray reflectometry."* Richter, C.A., N.V. Nguyen, J.A. Dura, and C.F. Majkrzak, AIP Conference Proceedings, 1998(449): p. 185-189.
34. *"Neutron reflectometry, X-ray reflectometry, and spectroscopic ellipsometry characterization of thin SiO/sub 2/ on Si."* Dura, J.A., C.A. Richter, C.F. Majkrzak, and N.V. Nguyen, Applied Physics Letters, 1998. 73(15): p. 2131-2133.
35. *"Thickness determination of ultra-thin SiO/sub 2/ films on Si by spectroscopic ellipsometry."* Nguyen, N.V. and C.A. Richter, Proceedings of the Symposium on Silicon Nitride and Silicon Dioxide Thin Insulating Films, 1997: p. 183-193.
36. *"Novel Magnetic Field Characterization Techniques for Compound Semiconductor Materials and Devices."* Richter, C.A., D.G. Seiler, J.G. Pellegrino, W.F. Tseng, and W.R. Thurber, Semiconductor Characterization: Present Status and Future Needs, 1996: p. 673-677.
37. *"Quantum conductance fluctuations in the large-size-scale regime."* Richter, C.A., D.G. Seiler, and J.G. Pellegrino, Physical Review B (Condensed Matter), 1996. 53(19): p. 13086-13090.
38. *"X-ray reflectivity determination of interface roughness correlated with transport properties of (AlGa)As/GaAs high electron mobility transistor devices."* Dura, J.A., J.G. Pellegrino, and C.A. Richter, Applied Physics Letters, 1996. 69(8): p. 1134-1136.
39. *"Mesoscopic conductance fluctuations in large devices."* Richter, C.A., D.G. Seiler, and J.G. Pellegrino, 22nd International Conference on the Physics of Semiconductors, 1995: p. 1967-70 vol.3.
40. *"Buffer layer-modulation-doped field-effect-transistor interactions in the Al/sub 0.33/Ga/sub 0.67/As/GaAs superlattice system."* Pellegrino, J.G., C.A. Richter, J.A. Dura, P.M. Amirtharaj, S.B. Qadri, and B. Roughani, Journal of Vacuum Science & Technology A (Vacuum, Surfaces, and Films), 1995. 13(3): p. 787-791.
41. *"Transitions between edge and bulk channels in the quantum Hall regime."* Richter, C.A., R.G. Wheeler, and R.N. Sacks, Surface Science, 1994. 305(1-3): p. 145-150.
42. *"Metrology for Molecular Electronics."* Richter, C.A. and D.R. Stewart, GOMAC Digest of Technical Papers, GOMACTech 2003, 1993. 28: p. 281-284.
43. *"Overshoot of quantum Hall plateaus."* Richter, C.A., R.G. Wheeler, and R.N. Sacks, Surface Science, 1992. 263(1-3): p. 270-274.
44. *"New resistivity for high-mobility quantum Hall conductors."* McEuen, P.L., A. Szafer, C.A. Richter, B.W. Alphenaar, J.K. Jain, A.D. Stone, R.G. Wheeler, and R.N. Sacks, Physical Review Letters, 1990. 64(17): p. 2062-2065.

Selected Presentations:

- Invited *"Top-Metal/Molecular Monolayer Interactions and Final Device Performance,"* NASA INAC Molecular Conductivity and Sensor Workshop, July 28, 2005.
- Invited. *"Nanoelectronic Device Metrology." Semiconductor International's* "Metrology in the Nanotech Era" technology webcast. June 22, 2005.
- Invited *"Molecular Electronics Tutorial,"* 2005 International Reliability Physics Symposium, San Jose, CA, April 18, 2005.
- Invited *"Electrical and Optical Characterization of Metal/Molecule Interfaces,"* Symposium on Nanotechnology, HP/QRS Labs, San Jose, CA, March 25, 2005.
- *"Electrical characterization of top-metal/molecule interactions in molecular electronic devices."* Molecular-Scale Electronics VII (Engineering Conferences International), San Diego, CA, Jan. 23-26, 2005.
  Plenary/Invited *"NanoElectronic Device Metrology,"* Nano and Microsystems Technology and Metrology Workshop 2004, Hunstville, Alabama, November 17, 2004.
- Invited *"COMPUTATIONAL NEEDS FOR EMERGING MATERIALS: AN EXPERIMENTAL METROLOGIST'S VIEWPOINT."* Materials Modeling for Emerging Research Materials Workshop (2005 ITRS), Austin, Texas USA, 6/8/04.
- Invited *"METROLOGY FOR THE INTEGRATION OF NANOELECTRONIC DEVICES."* DARPA Workshop on the Integration of Scalable CMOS Systems with Novel Nanostructures, 1/13/04.
- *"ELECTRICAL CHARACTERIZATION OF MOLECULAR MONOLAYERS FORMED BY DIRECT ATTACHMENT TO SI."* 34th Semiconductor Interface Specialists Conference, Arlington, VA USA, 12/4/03.
- *"MOLECULAR ELECTRONIC DEVICES FORMED BY DIRECT MONOLAYER ATTACHMENT TO SILICON."* 2003 International Semiconductor Device Research Symposium, Washington, DC USA, 12/12/03.
- Invited *"Measuring Electrical Properties: From Single Molecules to Moletronic Devices,"* DARPA Moletronics PI Review Meeting, McLean, VA, 7/27/03.
- Invited *"Metrology for Molecular Electronic Devices, 2003 Summer Workshop on Molecular Conduction,"* NASA Institute for Nanotechnology and Computing, Purdue University, 7/10/03.
- Invited *"Metrology for Molecular Electronics, GOMACTech-2003: Countering Asymmetric Threats,"* Tampa, Florida, April 2003.
- Invited *"Metrology for Molecular Electronics, University of North Texas Materials Science and Engineering Department,"* Denton, TX, 4/30/2003.
- *"Molecular Electronic Test Structures Based Upon Si_3N_4 Nanopores,"* 1st International Conference and School Nanoscale/Molecular Mechanics, Maui, Hawaii, May 14, 2002.
- *"Molecular Electronic Test Structures,"* Bulletin of the American Physical Society, Vol. 47, No. 1, pp. 285-285, (01-MAR-2002).

- *"Differences Between Quantum-Mechanical Capacitance-Voltage Simulators,"* the 2001 International Conference on Simulation and Semiconductor Processes and Devices, Athens, Greece, September 6, 2001
- *"Electrical Characterization: Molecular Test Structures,"* DARPA - Washington Area Molecular Electronics, Arlington, VA, June 11, 2001.
- *"Electrical Characterization: Molecular Test Structures,"* Hewlett-Packard Labs, Palo Alto, CA, May 29, 2001.
- *"Highlights of Advanced Gate-Dielectric Characterization and Reliability at NIST,"* Yale University, New Haven, CT, 3/30/01.
- *"Optical and Electrical Thickness Measurements of Alternate Gate Dielectrics: a Fundamental Difference,"* 2000 International Conference on Characterization and Metrology for ULSI Technology, Gaithersburg, MD, June 26, 2000.
- Invited *"Ellipsometry of Oxynitride and High-k Materials,"* International SEMATECH Metrology Council, Austin, TX, November 4, 1999.
- Invited *"NIST/SEMATECH Optical/TEM/Analysis of High-K Samples,"* SEMATECH Gate Stack Engineering Working Group, Raleigh, NC, November 11, 1999.
- Invited *"Quantum Mechanical Device Simulation Benchmarking,"* SEMATECH Gate Stack Engineering Working Group, Raleigh, NC, November 11, 1999.
- Invited *"Quantum Mechanical Device Simulation Benchmarking,"* International SEMATECH Metrology Council, Austin, TX, November 04, 1999.
- *"Analytical Spectroscopic Ellipsometry of Ta2O5 and TiO2 for use as High-k Gate Dielectrics,"* 30th IEEE Semiconductor Interface Specialist Conference, Charleston, SC, December 2, 1999.
- *"Spectroscopic Ellipsometry of Ta_20_5 on Si,"* MRS Symposium on Ultrathin SiO_2 and High-K Materials for ULSI Gate Dielectrics, San Francisco, CA, April 8, 1999.
- *"Ellipsometry as a Gate Dielectric Characterization Tool,"* SEMATECH Analytical Lab Managers Working Group, NIST, Gaithersburg, MD, April 28, 1999.
- *"Characterization of Thin SiO_2 on Si by Spectroscopic Ellipsometry, Neutron Reflectometry, and X-Ray Reflectometry,"* The 1998 International Conference on Characterization and Metrology for ULSI Technology, Gaithersburg, Maryland, March 23-27, 1998.
- *"Characterization of thin SiO2 on Si by Neutron Reflectivity, X-ray Reflectivity, and Spectroscopic Ellipsometry."* Bull. . Amer. Phys. Soc. **43** p. 621, (1998).
- *Spectroscopic Ellipsometry, Neutron Reflectivity, and X-ray Reflectivity Characterization of SiO_2 on Si.* The 28th IEEE Semiconductor Interface Specialist (1997).
- *"Quantum electrical measurements of SiO_2/Si Interface Roughness in MOS Transistors,"* The 27th IEEE Semiconductor Interface Specialist Conference (1996).
- *"Novel Magnetic Field Characterization Techniques for Compound Semiconductor Materials and Devices."* Semiconductor Characterization: Present Status and Future Needs (1996).
- *Transport properties of superlattice minibands determined using a minibandtransport quantum well infrared photodetector."* Bull. Amer. Phys. Soc. **41**, (1996).

- *“Universal Conductance Fluctuations in "Macroscopic” Devices.* Bull. Amer. Phys. Soc. **40**, p. 400 (1995).
- *“X-ray Reflectivity Measurements of Interface Roughness Correlated with MODFET Transport Properties.*” Bull. Amer. Phys. Soc. **40**, p. 395 (1995).
- *“Mesoscopic conductance fluctuations in large devices.”* 22nd International Conference on the Physics of Semiconductors, Vancouver, Canada, August 1994.
- *“Magnetic field modulation studies of the two-dimensional magnetophonon effect in GaAs.”* Bull. Amer. Phys. Soc. **39,** 750 (1994).
- *"Transitions between edge and bulk channels in the quantum Hall regime."* The 10th International Conference on the Electron Properties of Two-Dimensional Systems, Newport, RI (1993).
- *“Inter Landau level transitions in the quantum Hall Regime.”* Bull. Amer. Phys. Soc. **38,** 179 (1993).
- *"Overshoot of quantum Hall plateaus."* The 9th International Conference on the Electron Properties of Two-Dimensional Systems, Kyoto Japan (1991).
- *“Overshoot of spin plateaus in the quantum Hall Regime.”* Bull. Amer. Phys. Soc. **36**, 598 (1991).
- *“Quantization of longitudinal resistance in the quantum Hall regime.*” Bull. Amer. Phys. Soc. **35**, 539 (1990).